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PROCEDURES FOR HANDLING BYPRODUCTS REMOVED DURING BEEF BONING

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PREFACE

This report contains information that can be used in selecting the most economical methods of handling the byproducts that are removed from beef carcasses during the boning process. Future reports will evaluate the entire boning operation.

Appreciation is expressed to the operators who made their lines available for detailed studies. Credit is also due to the following equipment suppliers who provided cost estimates for a number of items: Koch Supplies Incorporated, Phil Hantover Incorporated, and Laughlin Manufacturing Company.

This work was conducted under the general supervision of Tarvin F. Webb, investigations leader, Transportation and Facilities Research Division, Agricultural Research Service.

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PROCEDURES FOR HANDLING BYPRODUCTS REMOVED DURING BEEF BONING

by

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INTRODUCTION

Plants and other facilities for boning beef[1/] in the Southwest and Midwest generally specialize in carcasses that are in the lower (Canner, Cutter, and Utility) USDA grade ranges. The byproducts from these carcasses--bones, scrap (inedible trimmings), and excess fat removed--represent about 25 percent of the total carcass in-weight and usually less than 2 percent of the total selling price.[2/]

To the beef boner, these byproducts become a handling problem as soon as they are removed from the meat. In some instances, they not only require space for containers both at the boning stations and at the area where empty and filled containers are held, but also labor to transport them from the boning area. Since bones and scrap normally are placed together and comprise from 86 to 92 percent of the total byproduct weight, many operators also place the excess fat with the bones and scrap to reduce the number of containers in the boning area and to minimize the labor needed.

A total of 17 boning lines were observed to obtain background information on byproduct handling, and detailed case studies were made at six selected lines. The lines were located in refrigerated warehouses, in separate buildings, and at slaughter plants. The number of carcasses boned daily ranged from less than 75 to about 325.

The objectives of the research were to evaluate the procedures for handling byproducts and to determine which procedure was the most efficient. To obtain the necessary information, time studies were made of the in-plant labor used to transport the containers. Floorspace requirements for containers, other transport equipment, and aisles were calculated from data based on volume boned and type of equipment used. Finally, operators and supervisory personnel were interviewed to obtain supplemental data, such as average

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1/ Beef may be boned at almost every level of the meat-marketing industry. However, the work lines that bone beef ("beef-boning lines") are frequently found in independently operated beef-boning plants that have layouts designed exclusively for the boning process.

2/ The byproducts of beef boning are commonly sold to operators of rendering plants.

percentage of each carcass sold for rendering, average weight of carcasses, equipment installation and maintenance costs, and wage rates.

Boning operators were interested in knowing the costs for different procedures used in handling boning byproducts. This report provides the information requested. Operators planning a boning line also can use these data as guidelines to determine the best handling procedure for their byproducts in accordance with volume and distance of transport. The report compares the ownership and operating costs of five types or combinations of equipment and the labor and floorspace costs for lines boning from 25 to 350 carcasses daily and transporting the byproducts a distance of 30 to 65 feet.

METHOD OF COMPUTING COSTS

This study excludes the costs of management and all other costs usually classified as overhead. It covers only the equipment, labor, and floorspace costs involved in the handling of byproducts of beef boning.

For the purposes of this study, equipment ownership costs include (1) f.o.b. factory costs based on 1966 prices; (2) a transportation charge for shipping the equipment 500 miles; (3) a cost for materials and labor required to install the equipment; (4) depreciation; (5) interest on investment; and (6) insurance and taxes. Installation costs were estimated by several concerns that regularly do this work. Depreciation of the equipment was computed by the straight-line method for 12 years with no residual value. Interest was based on 6 percent of the average investment over the depreciable life of the equipment. Insurance and taxes were based on a combined figure of 4 percent of the initial investment.

Operating costs for equipment include electricity, when applicable, and maintenance. Cost of electricity was based on $0.02 per kilowatt hour for a running time of 2,080 hours annually. Maintenance cost estimates were made by operators, equipment suppliers, and the authors. The cost for cleaning the equipment was not included.

The wage rates paid to the employees that handled the byproducts varied widely from one section of the country to another and, in some cases, in the same metropolitan area. Because of these variations, a wage rate of $2.50 per hour was assumed. This rate includes the basic hourly wage plus fringe benefits, such as social security, hospitalization, and workmen's compensation.

Cost estimates, based on the latest construction data available, indicated that each square foot of floorspace would cost about $20 to build and to refrigerate to 50° F. Building ownership costs also included depreciation computed by the straight-line method for 30 years with no residual value, interest on investment based on 3.3 percent for the depreciable life, and insurance and taxes, which were computed by using a combined figure of 4 percent of cost. A 1-percent allowance for maintenance of facility was the only operating cost included.

BYPRODUCTS HANDLING

This report is limited to the transport and storage of byproducts from the time they are removed from the carcass meats until they are ready to be loaded into the renderer's truck or bulk container. Five different types or combinations of equipment normally are used for byproducts handling (fig. 1).

Operators of some boning lines use a combination of 55-gallon barrels and a two-wheel handtruck for transport. This combination is popular since the boning-line operator has to supply only one, or possibly two, handtrucks. The business concern buying the byproducts normally furnishes the barrels. With this combination, a plant worker can transport from 125 to about 200 pounds of byproducts each trip. At least one barrel is usually provided for each boner.

Another type of equipment used is the two-wheel general-purpose truck. Boning-line operators usually have to supply these trucks. Several boners generally deposit byproducts in each truck. A load weighs between 400 to 800 pounds and can be transported by one plant worker.

The overhead belt conveyor, the barrels, and the handtruck form another combination. The byproducts are moved from the work area by the conveyor to a chute at one end, where they are dropped into a 55-gallon barrel. One barrel is kept under the chute and at least one empty barrel is placed beside it. A two-wheel handtruck is used to transport the barrels.

The same conveyor-and-chute setup may be combined with a two-wheel general-purpose truck. In this combination, two trucks are generally located at the chute, with one positioned under it for filling. A worker is needed to empty and return the trucks.

In a fifth combination, two overhead belt conveyors are used to form a multiple-conveyor system. One conveyor transports the byproducts from the boning stations to a second conveyor, which moves them outside the plant and dumps them into the renderer's bulk container or truck.

Six of the 17 lines observed used the barrel and handtruck combination, eight used the multiple-conveyor system, and the remaining three used one of the other types or combinations of equipment (figs. 2, 3, and 4). The volume of carcasses boned daily by these lines had no relation to the type or combination of equipment used. Several of the smaller lines that boned 100 carcasses or less, and the largest line, which boned 325 carcasses, used a multiple-conveyor system. Barrels and a handtruck were used by lines that boned from 75 to 300 carcasses. The method of moving byproducts from the boning area was affected by the daily volume boned and by such conditions as the type of boning equipment used (conveyor table or regular worktable), wage rate of boners (regular or incentive pay), and the size and arrangement of the different work areas in the facility.

In the plants studied, the in-weight of the beef carcasses boned ranged from 375 to about 650 pounds; however, at most of the plants, the average weight of the carcasses boned was about 450 pounds.

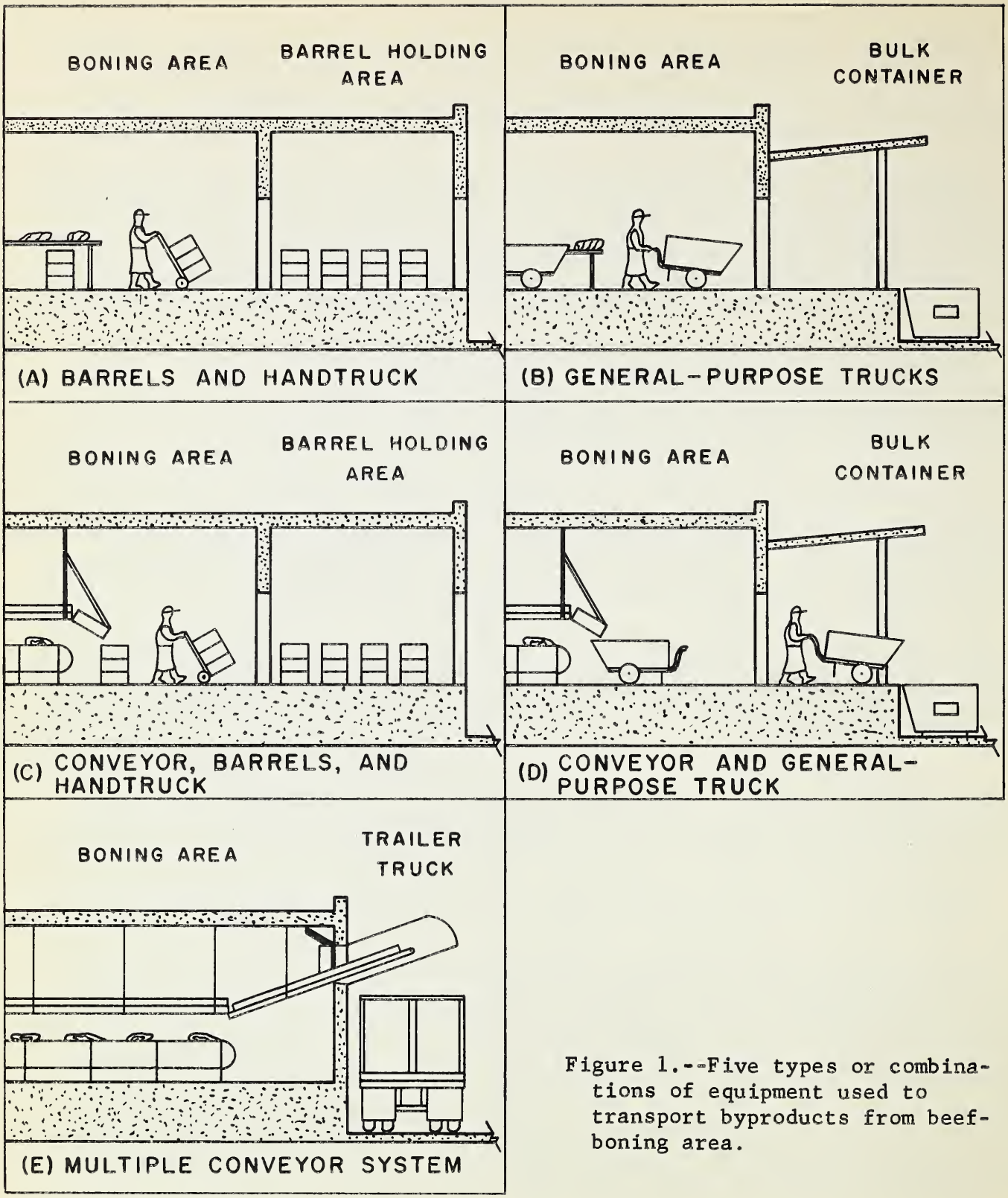

Figure 1.--Five types or combinations of equipment used to transport byproducts from beef-boning area.

Figure 2.--Overhead-belt conveyor, chute, and general-purpose trucks are used for removing byproducts from boning-table conveyor.

Figure 3.--A second overhead-belt conveyor used to transport byproducts of beef boning from first conveyor to renderer's truck outside plant.

Figure 4.--Conveyor deposits byproducts from beef-boning line in renderer's truck. Hood over conveyor protects conveyor belt from inclement weather and reduces chance of dust and insects entering boning workroom.

The weight of byproducts placed in a barrel or general-purpose truck varied according to the composition of the byproduct, the compactness of the material in the container, and the worker's opinion of how large a load he should convey per trip. The weight of byproducts when placed on the overhead conveyors was disregarded as it did not affect the handling operation.

In plants that used barrels or general-purpose trucks, one worker was usually assigned the job of transporting full containers to the load-out area and empty containers to the boning area. Since this worker generally performed other work when he was not needed to transport containers, the man-hour requirements and costs considered were based on the actual time devoted to emptying and returning containers and no "wait time" was included.

All five types or combinations of equipment required floorspace in the boning area. A 55-gallon barrel needed about 4 square feet of floorspace and a general-purpose truck needed about 20 square feet. One of the two overhead conveyors in the multiple-conveyor system was installed above the boning-table conveyor and thus did not use floorspace. However, the outgoing conveyor, which transported the byproducts to the renderer's truck, extended across the room from the end of the first conveyor to the outside wall and either reduced or eliminated the use of floorspace under and immediately adjacent to it. The outgoing conveyor was about 15 feet long in all plants, with about 10 feet inside the boning area. A belt 24 inches wide was generally used for this conveyor, and when the frame and suspension brackets were included, the conveyor averaged 36 inches in width. It required about 30 square feet (3 by 10 feet) of floorspace.

In addition to the actual space occupied by barrel, truck, or outgoing conveyor, aisle space was needed to maneuver barrels and trucks into and out of position and to service the belt conveyor. About 11 square feet was needed for each handtruck and barrel for maneuvering and 29 square feet for each general-purpose truck. Thirty square feet (3 by 10 feet) for servicing the outgoing conveyor should be adequate.

The total square footage provided in the boning area for each piece of equipment was 15 for handtrucks and barrels, 49 for general-purpose trucks, and 60 for outgoing conveyors.

The number of trips a renderer's truck made to a boning line depended on such things as the volume of byproducts produced each hour, the accessibility of the rendering plant to the boning line, and the type of equipment used to transport the byproducts within the boning house. Some nearby renderers picked up byproducts every hour or so if 100 or more carcasses were boned daily and if either barrels or general-purpose trucks were used.

After they were removed from the boning area, byproducts were temporarily stored in a number of different ways. When barrels were used, byproducts were normally placed in a refrigerated area near the load-out dock. General-purpose trucks were handled the same as barrels or moved to an outside dock where the byproducts were dumped into a renderer's bulk container. The space required in the refrigerated area for storing each barrel was 4 square feet and for storing a truck, 20 square feet. Since both barrels and trucks were

placed close together in this area, aisle space for maneuvering was insignificant and was not included.

As described earlier, the second conveyor of a multiple-conveyor system moved byproducts directly to the renderer's truck. Since this second conveyor extended from the refrigerated work area inside the building to the outside through an opening in the wall, several pieces of equipment were needed to protect the quality of the meat being boned and to prevent a loss of refrigeration. An air door or fan was needed on the inside wall to circulate air across the wall opening. (This provision for air circulation prevents insects and dust from entering and helps maintain the temperature within the boning area.) Also, a metal hood on the outside wall to protect the belt conveyor from inclement weather was needed, as well as a small door on the inside wall to close the conveyor opening when the boning line was not operating.

From the data obtained in field studies of boning lines, from information supplied by the equipment manufacturers, and from estimates and assumptions provided by the authors, the five types or combinations of equipment used to move byproducts were compared. These comparisons, discussed in the next section, cover the handling of selected volumes of byproducts for different transport distances.

COMPARISON OF PROCEDURES FOR HANDLING BONING BYPRODUCTS

To provide a basis for comparing equipment requirements, the following data obtained from the evaluation of case studies were used: (1) The byproducts from each carcass weighed an average of 112.5 pounds; (2) the weight of each loaded barrel was 155 pounds and the weight of each general-purpose truck was 635 pounds; (3) man-hour requirements were limited to time spent in transporting full and empty barrels and trucks between the boning and storage areas; (4) 15 square feet of floorspace was needed in the boning area for each handtruck and barrel, 49 for each general-purpose truck, and 60 for each outgoing conveyor (table 1); (5) 4 square feet of floorspace for each barrel and 20 for each truck was needed in the temporary storage area; and (6) a 2-hour supply of either barrels or trucks had to be kept on hand at boning lines that used them. The procedure followed in computing ownership and operation costs for equipment, floorspace and wages was covered earlier in the report.

The average daily volume boned and the distance the byproducts are transported (one way) are the two major factors considered in developing the direct costs for each of the five types or combinations of equipment covered in this study. Since the transport distance for byproducts was generally determined by volume boned daily, boning equipment used, and facility layout, these data were compiled for the following selected volumes and distances byproducts were transported:

Carcasses boned daily-----	25-150	50-250	100-300	150-350
Transport distance--feet--	30	40	50	65

TABLE 1.--Container and floorspace requirements for different types or combinations of equipment used in handling byproducts of beef-boning lines

Equipment	Carcasses boned daily	Containers		Floorspace	
		Boning area	Storage area	Boning area	Storage area
	Number	Number	Number	Square feet	Square feet
Barrels and handtruck	25	3	3	45	12
General-purpose trucks	25	1	-	49	-
Conveyor, barrels, and handtruck	25	2	4	30	16
Conveyor and general-purpose trucks	25	1	-	49	-
Multiple-conveyor system	25	-	-	60	-
Barrels and handtruck	50	5	5	75	20
General-purpose trucks	50	2	-	98	-
Conveyor, barrels, and handtruck	50	2	8	30	32
Conveyor and general-purpose trucks	50	1	-	49	-
Multiple-conveyor system	50	-	-	60	-
Barrels and handtruck	100	9	9	135	36
General-purpose trucks	100	4	-	196	-
Conveyor, barrels, and handtruck	100	2	16	30	64
Conveyor and general-purpose trucks	100	2	-	98	-
Multiple-conveyor system	100	-	-	60	-
Barrels and handtruck	150	14	14	210	56
General-purpose trucks	150	6	-	294	-
Conveyor, barrels, and handtruck	150	2	26	30	104
Conveyor and general-purpose trucks	150	2	-	98	-
Multiple-conveyor system	150	-	-	60	-
Barrel and handtruck	200	18	18	270	72
General-purpose trucks	200	8	-	392	-
Conveyor, barrels, and handtruck	200	2	34	30	136
Conveyor and general-purpose trucks	200	2	1	98	20
Multiple-conveyor system	200	-	-	60	-
Barrels and handtruck	250	23	23	345	92
General-purpose trucks	250	10	-	490	-
Conveyor, barrels, and handtruck	250	2	44	30	176
Conveyor and general-purpose trucks	250	2	1	98	20
Multiple-conveyor system	250	-	-	60	-
Barrels and handtruck	300	27	27	405	108
General-purpose trucks	300	12	-	588	-
Conveyor, barrels, and handtruck	300	2	52	30	208
Conveyor and general-purpose trucks	300	2	2	98	40
Multiple-conveyor system	300	-	-	60	-
Barrels and handtruck	350	32	32	480	128
General-purpose trucks	350	14	-	686	-
Conveyor, barrels, and handtruck	350	2	62	30	248
Conveyor and general-purpose trucks	350	2	2	98	40
Multiple-conveyor system	350	-	-	60	-

When the transport distance is about 30 feet and the average number of carcasses boned daily ranges from 105 to 140, a conveyor and general-purpose truck are the least costly (fig. 5). The multiple-conveyor system is the most economical when the number of carcasses is above 140 daily. When the number of carcasses is below 105, the general-purpose truck is recommended. The barrel-handtruck combination, requiring the smallest investment, has an annual cost almost 1-3/4 times that of the general-purpose truck when 25 carcasses are boned daily and 1-1/2 times the truck cost at 150 carcasses. The annual costs for the multiple-conveyor system increase only slightly for a daily volume of carcasses ranging between 25 and 150. This is because belt life is the only cost item affected as volume handled changes.

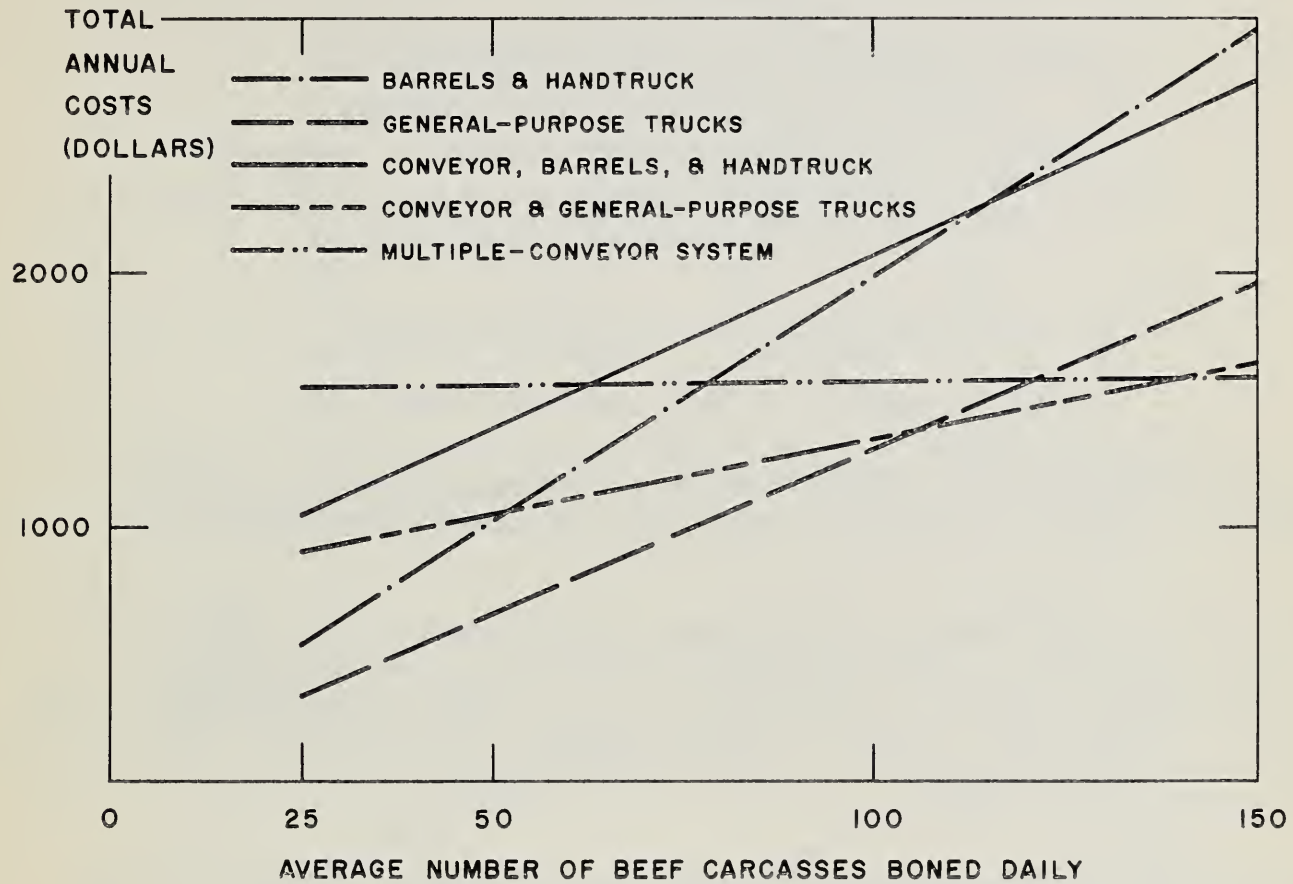

Figure 5.--Annual costs of transporting beef-boning byproducts 30 feet, based on volume of carcasses boned daily and handling equipment used.

A multiple-conveyor system has the lowest annual cost when the average transport distance is 40 feet and 150 to 250 carcasses are boned daily (fig. 6). When the daily volume is between about 125 and 150 carcasses, the best choice is the belt conveyor and general-purpose truck. The truck used alone is the cheapest type of equipment when the daily volume of carcasses boned is below 125.

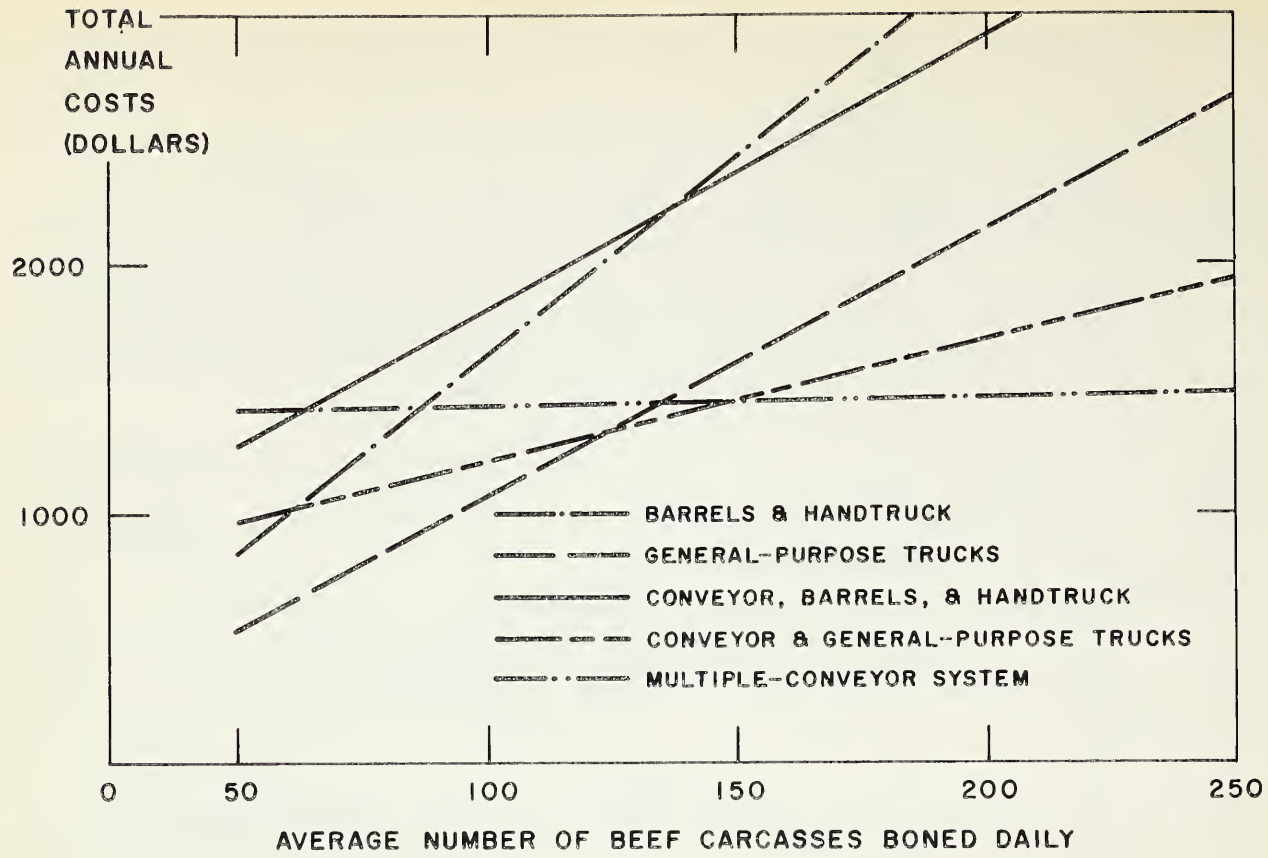

Figure 6.--Annual costs of transporting beef-boning byproducts 40 feet, based on volume of carcasses boned daily and handling equipment used.

When the average daily boning volume ranges between about 150 to 300 carcasses, byproducts can be transported 50 feet more economically if a multiple-conveyor system is used (fig. 7). For a daily boning average of 300 carcasses, the multiple-conveyor system's annual costs are about $700 less than the costs for the next lowest equipment combination and about one-third of the barrel and handtruck costs.

For transporting byproducts 65 feet, general-purpose trucks are recommended for daily volumes of up to 175 carcasses, and the multiple-conveyor system is recommended for larger volumes (fig. 8). However, although the multiple-conveyor system cannot be justified for a 65-foot transport when the daily volume is less than 175 carcasses, it is more economical for a 50-foot transport when the daily volume is above 150. The reason for this rise in annual costs as the volume increases is that a larger drive motor is needed as well as a heavier conveyor frame. Also, the type of belt used is the same on all conveyor lengths, and its life varies directly with its length. For example, the shorter the belt, the longer the life.

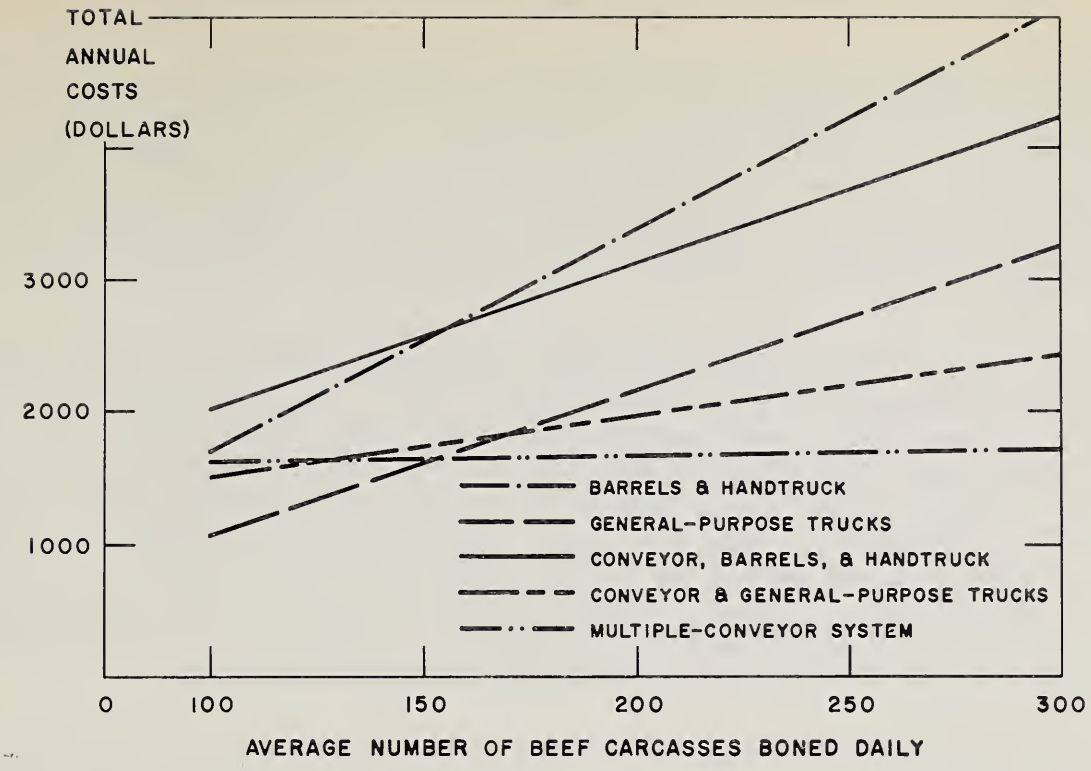

Figure 7.--Annual costs of transporting beef-boning byproducts 50 feet, based on volume of carcasses boned daily and handling equipment used.

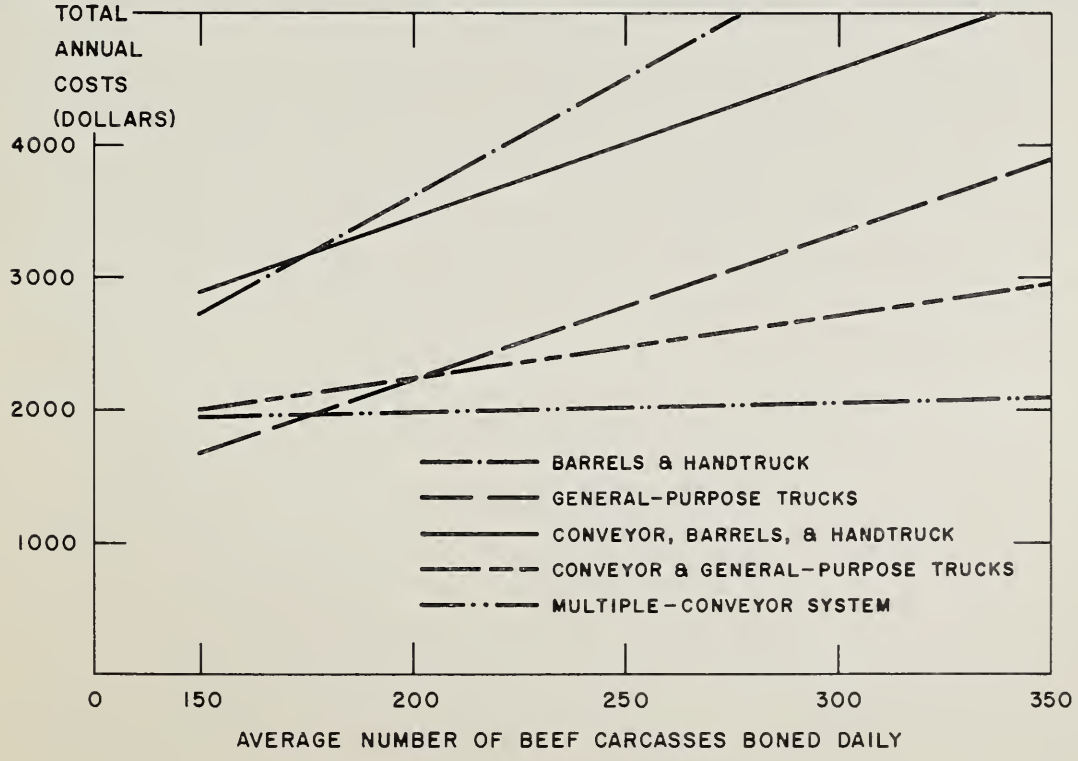

Figure 8.--Annual costs of transporting beef-boning byproducts 65 feet, based on volume of carcasses boned daily and handling equipment used.

CONCLUSIONS

A conveyor system is the best choice for handling byproducts of a beef-boning line when the average number of carcasses boned daily exceeds about 150 and the byproducts are transported 30 to 50 feet. For a transport distance of 65 feet, a conveyor system is suggested for a daily volume of 175 or more carcasses. General-purpose trucks are cheaper at lower volumes, except for volumes between approximately 100 and 150 carcasses and a transport distance of 30 or 40 feet.

If this report is used as a guideline, the user should be aware that the evaluation of equipment was based on average costs. For this reason, he should obtain local cost estimates for equipment, construction, and labor, and related information, before he selects his equipment. For example, the cost of installing a conveyor system should be lower if the plant maintenance crew, rather than an outside contractor, does the work. This increase in labor costs could mean that in handling byproducts of beef boning, conveyor systems are more economical than the other types or combinations of equipment for the following volumes and distances: more than 120 carcasses at 30 feet, 130 carcasses at 40 feet, 140 carcasses at 50 feet, and 160 carcasses at 65 feet.

The type of byproduct transport used by the renderer can also be an important consideration in selecting the equipment for handling beef-boning byproducts. Although many renderers used large trucks to transport byproducts directly from boning-line conveyors to their plants, many firms can handle only barrels. If the boning-line operator must supply a truck in addition to the conveyor, he might find one of the other types or combinations of equipment more economical at any of the distances and for any of the volumes covered in this report.

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